BioSense Real-Time Data Initiative: Improving the Nation's Emergency Preparedness

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Background

BioSense is a national program intended to improve the nation's capabilities for conducting near real-time biosurveillance, enabling health situational awareness through access to existing data from healthcare organizations across the country such as VA, DoD, LabCorp and up to 350 hospitals by end of year 2006. Routine public health surveillance and investigations involve the manual reporting of cases to public health agencies and phone calls to healthcare providers for more detailed patient chart information. In public health emergencies these methods can be slow and incomplete. BioSense is a CDC-developed and hosted web-based system accessing existing data from healthcare organizations across the country. BioSense surveillance methods address the need of public health at all levels for identification, tracking, and management of rapidly spreading naturally occurring events and potential bioterrorism events using advanced algorithms for data analysis.

Methods & Data Flow

Hospital clinical data of interest include:

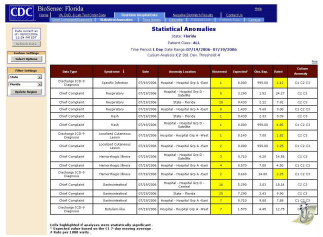
- **Foundational**: demographics (no obvious patient identifiers), chief complaint, discharge diagnoses, disposition, hospital utilization, working diagnosis
- **ED Clinical**: vitals, triage notes, discharge summary
- **Laboratory**: orders, microbiology results
- **Pharmacy**: medication orders
- **Radiology**: orders, interpretation results

Data sent to BioSense from participating hospitals and organizations are analyzed and visualized through a secure web application giving participating public health jurisdictions and hospitals access to rich data from emergency departments, outpatient clinics, and other hospital settings. During an emergency event, participating clinicians and local, state, and federal public health officials will have a real-time picture of how a community is affected. This information can help characterize and monitor an outbreak and will be critical for appropriate and timely public health interventions. BioSense can provide better coordination between public health with minimal impact on existing systems and advancement of information technology.

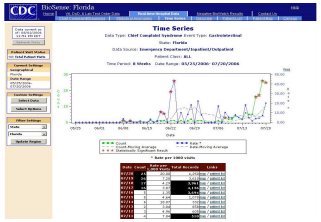
Analysis & Visualization of Data

BioSense uses a modification of the CuSum analysis model to identify anomalies. The revised approach is being called "W2". In this approach, the expected value for weekdays equals the mean of the previous 7 weekdays (with a 2-day lag); and the expected value for weekends equals the mean of the previous 7 weekend days (with a 2-day lag). By comparing the observed with expected value, a recurrence interval is calculated. The recurrence interval is the reciprocal of the p-value, (i.e., a p-value of 0.01 would equal a recurrence interval of 100 days). These changes will help users to focus on the data anomalies that are more likely to be important.

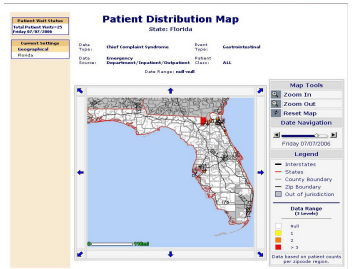
Below are screenshots from the demonstration application showing examples of how the data is visualized. The data shown below is **not** actual data:



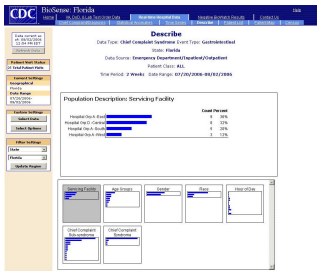
Statistical anomalies are highlighted in yellow to easily reference a potential event.



The line graph on the Time Series page shows trends and spikes. The chart focuses on day-by-day data.



Mapping allows local and state public health officials to view respective jurisdictions and the events occurring within. View can be changed to show additional labeling including zip-codes, borders, county name, etc.



The Describe area allows data to be segmented in a variety of ways including factors such as age, race, gender, sub-syndrome, syndrome, and population of servicing facility.

* Screenshots from the application using W2 analytics were not available at the time of printing. Shots above are from a previous application using standard CuSum analytics. However functionalities remain the same

Impact of BioSense on Public Health

- **Early event detection and confirmation**
  - Analysis method highlights higher importance anomalies
  - Reported events can be confirmed or disputed by reviewing relevant data
- **Health situational awareness**
  - Identify potentially related events
  - Track spread of outbreak
  - Assess progress of actions taken against event
- **Improved communication and facilitated coordination**
  - State and local public health can access same data as local hospital data source
  - All levels of public health will have access to the same data in near real-time.

Discussion

- Provide local, state, and nationwide health situational awareness for suspect illness and cases of disease before, during, and after a health event.
- Help to confirm or refute the existence of an event, monitor its size, location, and rate of spread.
- Expedite event recognition and response coordination among federal, state, and local public health and healthcare organizations.
- There is increased capacity for biosurveillance using existing clinical and diagnostic real-time data from hospital information systems.
- BioSense is a continually evolving system, adding new data sources and employing new statistical algorithms for near real-time biosurveillance and health situational awareness.

"The findings and conclusions in this presentation have not been formally disseminated by [the Centers for Disease Control and Prevention/the Agency for Toxic Substances and Disease Registry] and should not be construed to represent any agency determination or policy."